SPECIAL REPORT

FOR

U.S. Public School Administrators

The Last Mile:
Helping America's Schools Get Up to Speed

Submitted by:

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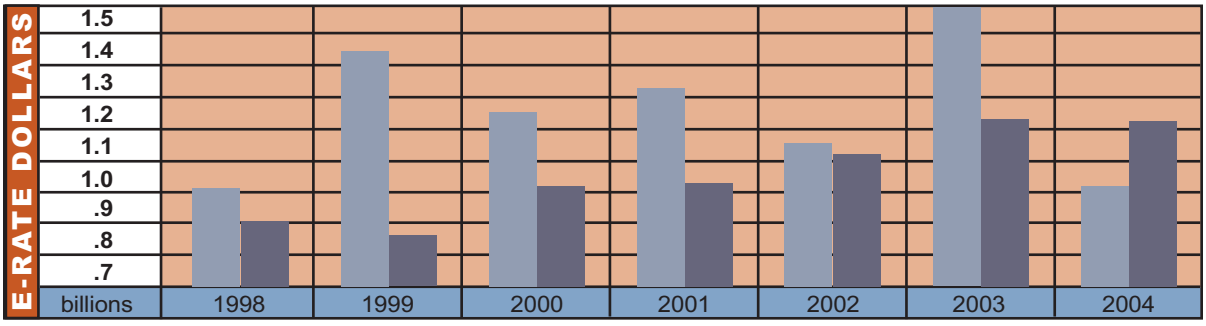
AMERICA'S K-12 CHALLENGES

Thousands of America's public schools are struggling to meet the challenges of an increasingly competitive new world of K-12 education in terms of more advanced student curricula, teacher credentials and in-school security. In support of the underlying objective of the *No Child Left Behind Act*, the U.S. Department of Education ("USDE") this year released an updated recommendation for a national technology education plan entitled, *Toward a New Golden Age in American Education: How the Internet, the Law, and Today's Students are Revolutionizing Expectations*. The report identifies seven major action steps for U.S. schools to be more effective:

- **Strengthen Leadership**
- **Consider Innovative Budgeting**
- **Improve Teacher Training**
- **Support E-learning and Virtual Schools**
- **Encourage Broadband Access**
- **Move Toward Digital Content**
- **Integrate Data Systems**

THE BANDWIDTH BOTTLENECK CRISIS

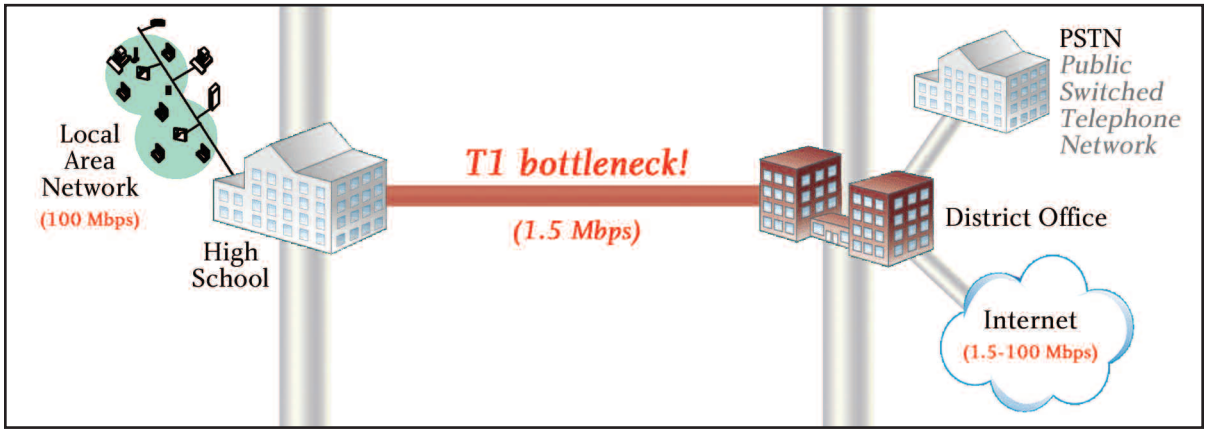
With annual support from the Universal Service Fund's E-Rate program, thousands of U.S. school districts are doing an admirable job of installing the *internal* high speed computer networks and basic internet service needed to begin taking advantage of new digital learning opportunities. However, partly as a result of this progress, **virtually all U.S. schools either are or will be running into severe bottleneck problems with their *external* network connections due to insufficient bandwidth.** These restrictions to on-line access and speed in our schools are caused by larger numbers of students and teachers simultaneously attempting to utilize media-rich internet, data and interactive video applications through conventional external last-mile connections, or "pipes," that cannot support schools' rapidly increasing network throughput requirements. Not surprisingly, 2004 was the first year in the history of the E-Rate program in which annual spending on external connections (telecom and internet services) was higher than spending on internal connections (computers and interior network equipment), a trend which is likely to continue.



Source: Universal Service Administration Company.

The vast majority of U.S. schools' current "high-speed" broadband connections are leased, dedicated phone company pipes known as "T-1's" that operate at maximum transmission speeds of 1.5 million bits of information per second (Megabits-per-second, or "Mbps") and are generally eligible for E-Rate service cost subsidies. Along with advanced coaxial cable lines that offer speeds of 3-5 Mbps, T-1s are a significant improvement over original "dial-up" modems, but they will quickly collapse under the weight of most schools' peak network loading requirements as demand for on-line, interactive multi-media applications grows.[1]

THE PIPE IS THE PROBLEM



HOW MUCH BANDWIDTH?

A report released in April 2005 by the U.S. Department of Education entitled *Distance Education Courses for Public Elementary and Secondary School Students* states that in the near future, **three-fourths of U.S. school districts plan to offer courses otherwise not available at their own schools over the Internet or through video conferences.** These types of high quality, multi-media services are extremely bandwidth-intensive. Compounding the swelling bandwidth requirements is the likelihood that distance learning connectivity will need to be available not just in computer labs but, ultimately, at each desktop so that various educational offerings can be simultaneously accessed by individual students. Consequently, the number of students concurrently requiring extremely high-speed, on-line access can be expected to grow exponentially – as will schools' aggregate bandwidth needs.

The chart on the following page illustrates the *estimated* aggregate external bandwidth capacity U.S. schools will require depending on how many users are simultaneously accessing various on-line applications and services.

ESTIMATED PEAK BANDWIDTH REQUIREMENTS PER SCHOOL							
No. of Connected Classrooms [1]	Voice over IP [2]	Business Applications [3]	Security Cameras [4]	Interactive Video to Classroom [5]	Basic Internet [6]	Interactive Video to Desktop [7]	Total Estimated Required Bandwidth Per School [8]
24	.8 Mbps	.8 Mbps	9 Mbps	12 Mbps	60 Mbps	180 Mbps	**83-251 Mbps**
20	.7 Mbps	.7 Mbps	8 Mbps	10 Mbps	50 Mbps	150 Mbps	**69-209 Mbps**
16	.6 Mbps	.6 Mbps	6 Mbps	8 Mbps	40 Mbps	120 Mbps	**55-167 Mbps**
12	.5 Mbps	.5 Mbps	5 Mbps	6 Mbps	30 Mbps	90 Mbps	**42-126 Mbps**
8	.4 Mbps	.4 Mbps	3 Mbps	4 Mbps	20 Mbps	60 Mbps	**28-84 Mbps**

notes

1. Based on 25 students per classroom.
2. 1/6 busy hour Erlang per phone and 25 students per phone (1 phone per class room), 1% blocking.
3. Basic Business Applications such as Microsoft Office, Email and Student Information Systems.
4. MPEG-4 Data Stream at 300 kbps per Camera and 1 camera for every 20 students.
5. H.323 standard at 512 Kbps per session and 25 students per session.
6. FCC definition of Broadband Services at 200 kbps upstream and downstream.
7. MPEG-4 Data Stream at 300 kbps to each desktop.
8. Does not include "Internet2" K.20 Initiative at 100 Mbps to each classroom. Range determined by interactive video to the classroom or desktop.

Source: Conterra, LLC, reviewed by independent K-12 and telecom industry experts.

The following is a more detailed description of some of the major applications and benefits only accessible to schools with ultra high-capacity, high-speed external broadband connectivity.

- **Enhanced curricula with sophisticated multi-media content regardless of number of users or time of day**
- **Internet connectivity, including "Internet2" at newly required access speeds (e.g.100 Mbps)**
- **Sharing of learning resources across schools and districts**

– electronic help desks

– educational databases

– school bulletin boards

– fax conferencing

- **Broadening of the learning experience with on-line applications for students, teachers and administrators**

– interactive courseware

– intelligent computer assisted instruction

– interactive multi-media instruction for students, teachers and administrators

– internet based instruction for teachers and students

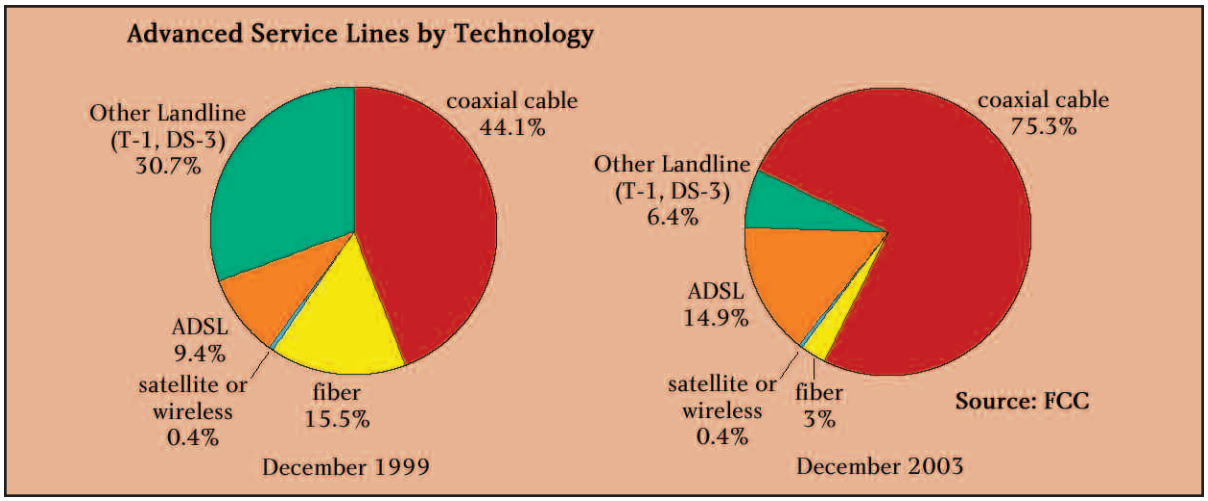
– inter-district video conferencing

– electronic testing & report cards

- **Increased in-school security reach and response time**
  - remote digital video observation utilizing IP-based cameras and digital video recorders
  - real-time monitoring connections to local law enforcement via the internet
- **Effective implementation of Voice-Over-IP ("VoIP") telephony solutions**
  - increased functionality over traditional phone systems
  - long distance voice and data cost reductions via internet carriers
- **Reduction of telecom operating expenses**
  - consolidation of multiple computer servers using WAN connectivity
  - remote software upgrades and control of computer content at each school

THE REALITY OF UNIVERSAL SERVICE

In spite of the burgeoning demand for K-12 wide area network ("WAN") bandwidth, according to the USDE and the FCC, **less than five percent of U.S. schools currently have access to fiber optic or high-speed wireless external connections.** Yet, these are the only two transmission media currently capable of providing the quality and scalability of bandwidth necessary to meet school districts' anticipated heavy payload requirements. The most pervasive current broadband pipes in the U.S., copper telephone and coaxial cable lines, are geared to the residential and small business markets which generally have considerably lower numbers of simultaneous users per location than schools and, therefore, require considerably less connectivity bandwidth.



The fact is, based on their location, population density and demographics, tens of thousands of K-12 schools in the United States are not likely to gain access to affordable, last-mile fiber connections in the next three to five years, if ever. Without rapid deployment of fiber optics or other equivalently robust broadband technologies, K-12 school systems–mostly in outer suburban and rural America where E-Rate support levels are generally highest–are not likely to keep pace with schools in our major cities (or in academically progressive foreign countries such as Japan and South Korea) in terms of equal access to new learning opportunities.[1] The potential result:

A DIGITAL DIVIDE

Left unaddressed, the potential disparity in the quality of baseline K-12 education could ultimately impair America's global competitiveness and prosperity.[1]

So the question is, in those parts of the country where optical fiber cannot be economically deployed, **"What can be done to help America's schools GET UP TO SPEED?"** And, just as important, **"Are the technology solutions affordable?"**

FILLING THE FIBER GAP

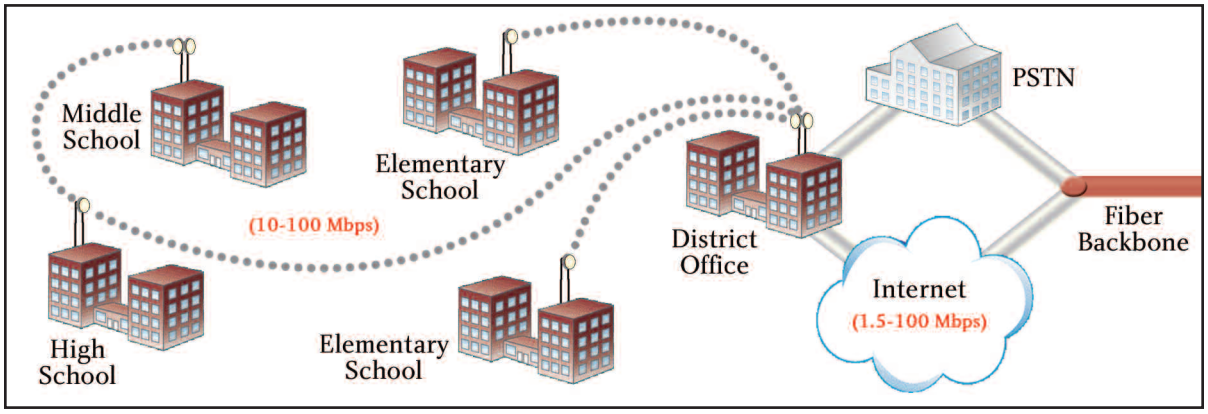
Based on the current laws of physics and economics, a ubiquitous broadband solution for U.S. K-12 schools will require the deployment of hybrid networks primarily consisting of optical fiber and high-speed wireless pipes.[1] Point-to-point microwave radio networks have been used to carry massive volumes of commercial voice and data traffic for decades. Major telecommunications companies including AT&T, MCI (Microwave Communications Inc.) and Sprint used common carrier microwave networks to haul traffic cross-country long before the advent of fiber optic networks. Recent advances in digital technology have permitted the use of higher radio frequencies and smaller antennae and have reduced the complexity and cost of these systems. This makes deployment of ultra high speed microwave networks much easier, quicker and more cost-effective, enabling service providers to lease affordable broadband access capacity to schools in underserved markets. **Wireless wide area network access services are eligible for federal E-Rate support.**

Digital microwave broadband networks can support ultra high-speed **(10 Mbps to 1 Gigabit)** Internet access and integrated data, video and VoIP services at capacity and reliability levels that rival fiber connections. This can only be accomplished, however, if service providers utilize radio frequencies *licensed* by the FCC, which guarantees protection against interference from other publicly available radio frequencies such as those used to operate baby monitors, garage door openers and weather-related radar systems. Wireless networks using *unlicensed* radio spectrum typically cannot operate at comparable carrier-grade quality or throughput levels.

FIBER-LEVEL SERVICE QUALITY

Properly engineered and maintained microwave radio systems have documented "mean-time-between-failure" rates of more than 20 years and are manufactured to withstand extremes of outdoor climates well beyond living conditions in all regions of the United States. These licensed radio frequencies can provide highly secure, fiber optics-level broadband services for schools within *only months* of entering into a service agreement with a an E-Rate eligible service provider, assuming E-Rate funding commitments for qualified projects are issued in a timely manner.

TYPICAL WIRELESS WAN DESIGN



WHY E-RATE AND BROADBAND ARE VITAL TO EDUCATIONAL EQUALITY

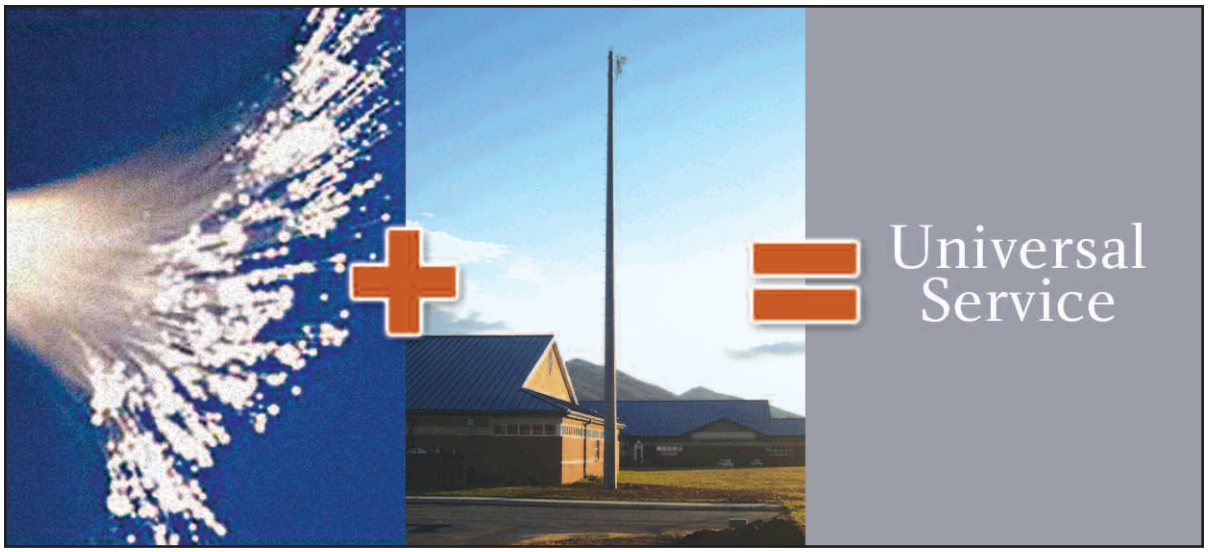
Ultra high-capacity, high-speed external broadband services provided by fiber optics and licensed microwave radio carriers will initially cost school districts considerably more absolute dollars than highly prevalent but increasingly outdated telephone company circuits because new, capital intensive networks must be designed and deployed. **However, due to the quantum increase in bandwidth provided to school districts by fiber or high-speed microwave, the cost-per-megabit of bandwidth used drops dramatically upon service conversion and should continue to drop as bandwidth users and usage grow.**

The following chart illustrates typical K-12 market rate data and economies of scale with respect to leading broadband service offerings.

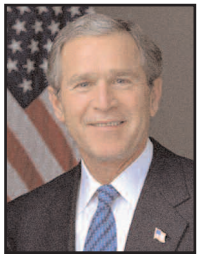
K-12 BROADBAND SERVICE COST/VALUE ANALYSIS						
PER CONNECTION	**T-1** (telco circuit)	**COAXIAL CABLE**	**DS-3** (telco circuit)	**UNLICENSED WIRELESS**	**OPTICAL FIBER**	**LICENSED MICROWAVE**
baseline throughput/bandwidth	1.5 Mbps	4 Mbps	45 Mbps	10 - 45 Mbps	10 - 100 Mbps	10 - 100 Mbps
scalable bandwidth?	no	no	no	no	yes	yes
maximum throughput/bandwidth	1.5 Mbps	4 Mbps	45 Mbps	45 Mbps	unlimited	1 Gbps
availability in non-urban areas	most locations	limited	most locations	any location	very limited	any location
transmission quality/ reliability/security	high	high	high	unreliable	high	high
carrier grade service level agreement?	yes	no	yes	no	yes	yes
typical monthly service cost *(Pre-Erate discount)*	$400 - $600	$180	$2500 - $4500	$1000 - $1400	$1000 - $2500	$1200 - $1800
typical monthly service cost PER MEGABIT *(Pre-Erate discount)*	$266 - $400	$45	$56 - $100	$100 - $31	$100 - $25	$120 - $18

Source: Publicly available representative rates from various regions of the country. Rates can vary based on prevailing tariffs and deployment cost variables such as distance and topography between site locations.

The problem is, to take advantage of these financial and technological economies of scale, poorer school districts must have the means to enter into multi-year service agreements that will ensure the economic justification for fiber and high speed wireless service providers to make major, long-term investments in network infrastructure so this substantially more efficient broadband capacity can be leased to underserved school districts.

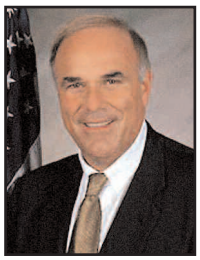


UNIVERSAL SERVICE REQUIRES UNIVERSAL SUPPORT



"It will mean we've got a more educated population when we get broadband technology spread throughout the entire country… [We must] make sure broadband technology is available in every corner of America by the year 2007."

President George W. Bush, June 2004



"Every school in Pennsylvania must have high-speed Internet service at affordable rates within the next 18 months."

Governor Edward Rendell, February 2004

THE BOTTOM LINE

It is imperative that Superintendents, Technology Directors, Instructional Coordinators, and Finance Directors join with the broadband vendor community to create the leadership necessary to bridge this growing "digital divide". Without that leadership, and without the federal E-Rate program's top-priority, uninterrupted support for helping America's schools gain ultra high-speed broadband access to the rapidly maturing world of advanced digital education, millions of U.S. school children and teachers, mostly in rural and outer suburban America, are at risk of being LEFT BEHIND their urban neighbors.

And, as history has repeatedly proven, a nation divided cannot stand.

[1]*IEEE-USA Committee on Communication and Information Policy - March 2005*

ABOUT CONTERRA

Conterra Ultra Broadband (Conterra, LLC), headquartered in Charlotte, NC, is a pioneer in the design, deployment and operation of digital, carrier-grade broadband systems for education, government, healthcare, and small to medium size businesses. Conterra's wireless WAN services operate at quality and performance levels equal to optical fiber connections.

Conterra's CEO, and author of this report, was a co-founder and CEO of Vanguard Cellular Systems, Inc. Started in 1982, Vanguard was one of the first "Cellular One" operators in the United States and provided wireless voice and data service in numerous rural and suburban markets. Vanguard is now part of Cingular Wireless.

Conterra's senior management team has decades of experience in wireless telecommunications, network services, broadband and K-12 technology solutions.